What We Know

- Before, during or after the cement job, an undetected influx of hydrocarbons entered the wellbore;
- The 9 7/8" casing was tested; the 9 7/8" casing hanger packoff was set and tested; and the entire system was tested;
- After 16.5 hours waiting on cement, a test was performed on the wellbore below the Blowout Preventer (BOP);
- During this test, 1,400 psi was observed on the drill pipe while 0 psi was observed on the kill and the choke lines;
- Following the test, hydrocarbons were unknowingly circulated to surface while displacing the riser with seawater;
- As hydrocarbons rose to the surface, they expanded, further reducing the hydrostatic pressure. The well flowed and witness account suggest that the Annular Preventer in the BOP and the Diverter were activated;
- An explosion occurred, followed by a power failure;
- Witness accounts suggest that the Emergency Disconnect System was activated;
- The rig was evacuated;
- The BOP system failed to work as intended. Flow was not contained and the Lower Marine Riser Package did not disconnect;
- Modifications have been discovered in the BOP system;
- Leaks have been discovered in the BOP hydraulics system;
- BP launched an investigation which is ongoing.

4. Open the annular preventer(s) and release the drill collars.
5. Close the blind/shear rams, after string has had time to clear the BOP's.
6. Read and record shut-in pressure and pit gain.
7. Great care should be taken to ensure safety of personnel during these operations.

2 SHEARING THE DRILLSTRING

Blind shear rams (BSR's) can be used to cut drillpipe and then act as blind rams in order to isolate the well.

Shearing the pipe is an operation that should be conducted only in exceptional circumstances and can be considered in the following situations:

- In preference to dropping the pipe in the event of an internal blowout.
- When it becomes necessary to move a floating rig off location at short notice.

When there is no pipe in the hole, the BSR's may be used as blind rams.

Most BSR's are designed to shear effectively only on the body of the drillpipe. Procedures for the use of BSR's must therefore ensure that there is no tool joint opposite the ram prior to shearing.

NOTE: Some subsea BOP stacks have insufficient clearance between the upper pipe rams and the BSR to hang-off on the upper rams and shear the tube of the pipe.

Rig personnel must know the capabilities (i.e. what size and grade of pipe can be sheared) and operating parameters of the shear rams installed in the rig's BOP stack.

Optimum shearing characteristics are obtained when the pipe is stationary and under tension. It is recommended that the string weight be partially hung off prior to shearing. Hanging off the pipe also ensures that there is no tool joint opposite the shear rams. Maximum operating pressure should be used to shear the pipe.

2.1 RECOMMENDED PRACTICE

1. Space-out to ensure that there is no tool joint opposite the shear rams.
2. Close the hang-off rams and hang-off the string.

EXECUTIVE SUMMARY

An Integrated Project Team was convened on January 8th, 2001 to provide a high level of confidence that the BOP system on the Deepwater Horizon is a reliable and safe system. The following summarizes the work completed by the RB Falcon, BP, Cameron, TSF and WEST team:

- The rig specific failures were reviewed and discussed in detail. The result of the review was that several recommendations for enhanced maintenance, equipment and procedures were developed.
- The industry failures that relate to the equipment on the Deepwater Horizon BOP System were discussed in detail. The results of this review were that a few recommendations were suggested for improved maintenance, testing and equipment change out or modification.
- A risk assessment focused on reliability was completed. Engineering and operations personnel from RB Falcon, BP, Cameron, TSF and WEST identified 260 failure modes that could require pulling of the BOP or LMRP. It was found that malfunctions of regulators, solenoids, hoses, ST-locks, connectors, shuttle valves and autoshear circuitry were the predominant failures. Additionally, several reliability-improving recommendations were proposed. The recommendations were a combination of design modifications, equipment replacement, improved PM and procedures.
- The revised running BOP procedures should be reviewed and accepted for use on the Deepwater Horizon. The BOP hang-off and retrieval procedure should be revised in a similar manner to the revision that was completed on the BOP running procedure.
- The hazards identified during the HAZID analysis should be issued to the rig so that the individuals responsible for running the BOP can be reminded of the hazards and critical steps associated with running the BOP. This information can be used to evaluate the criticality of any changes in procedure that occur due to equipment malfunctions or time constraints while running the BOP.
- The Gap analysis performed revealed that the major difference between the Deepwater Horizon and the Discoverer Enterprise BOP Assurance Analysis was the level of PM review completed. The Deepwater Enterprise team reviewed PM's in detail to make sure that the BOP maintenance is sufficient to uncover the major failure modes identified during the analysis and to ensure that the maintenance is performed at the appropriate frequency (i.e. quarterly, between well, etc.). Individual procedures were not reviewed during the Discoverer Enterprise BOP Assurance Analysis. The predominant failures from both analyses were similar; solenoids, hoses, connectors, shuttle valves and ram locking mechanisms.

It is important that all the recommendations associated with this analysis be reviewed and acted upon by the appropriate managers within RB Falcon.

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Enhanced Subsea Blow out Preventer (BOP) Stack Testing for Dynamically Positioned Rigs in the Gulf of Mexico

Purpose
Subsea BOP stacks are critical safety equipment designed to secure a well in the event of flow. They are tested to ensure that they will function and secure the well. The testing process also confirms there are no leaks in the system that would diminish system integrity. This file note is to document current subsea BOP stack testing practices for dynamically positioned (DP) rigs, and identify areas of enhancement for Gulf of Mexico (GoM) operations.

Standard Practices
Current GoM Mineral Management Service (MMS) regulations require BOP stacks to be stump tested at surface with water, pressure tested once installed on the well and then every 14 days thereafter. There is no GoM MMS regulatory requirement to test the BOP emergency systems once the BOP stack is installed subsea.

Global industry practice before running a BOP stack to the wellhead at the mud line is to function and pressure test it on the rig deck. Where not required by regulation, this is done to avoid unnecessary downtime. The surface test is performed by installing the BOP stack on a test stump and hooking up the hydraulic and electric power and the control systems. Since the BOP stacks have two redundant pod systems, the surface tests include both pods. The function and pressure testing of the BOP stack is typically done using one pod and then it is only function tested using the other pod. This function test includes actuating the components, but not pressure testing them. In addition to function and pressure testing the normal operating functions on the BOP stack, the emergency systems are tested as well. These systems include:

- Deadman
- Autoshear
- Emergency Disconnect System
- Remote Operated Vehicle (ROV) access

BOP stack emergency systems are not typically tested once the BOP stack is on the seabed.

The following is a summary of the emergency systems and how tests are typically performed on the test stump at surface.

Deadman
- Designed to close programmed rams when BOP stack loses hydraulics and electrical power
- Tested at surface by cutting the power and hydraulics to the BOP stack and verifying the programmed rams have closed

"BOP stack emergency systems are not typically tested once the BOP stack is on the seabed."